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**METHODS OF NATURAL SCIENCES IN DATING Rock ART MONUMENTS**

The article is dedicated to consideration of some features of applying achievements of natural sciences in archeology, in particular, dating of monuments of art.

Using the methods of natural sciences which development became more active today allows not only to obtain absolute dates for monuments of rock art, but also to reconsider the existing dating, and respectively, to introduce essential adjustment in our representation of history of the most ancient art. The radio-carbon analysis became the most widely used method of dating of monuments of rock painting today.

The fine arts played a special role in life of the ancient people, closely intertwining with religious and mythological ideas that allow speaking about thier syncretism.

**Keywords:** petroglyph, rock art, absolute dating, radio-carbon method, micro-erosion of chips, comparative analysis.

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**Методы естественных наук в датировании памятников наскального искусства**

Статья посвящена рассмотрению некоторых особенностей применения достижений естественных наук в археологии, в частности, датировании памятников искусства.

Использование методов естественных наук, развитие которых активизировалось в наши дни, позволяет не только получить абсолютные даты для памятников наскального искусства, но и пересмотреть существующие датировки, и, соответственно, внести существенные коррективы в наше представление об истории древнейшего искусства. Наиболее широко используемым методом датирования памятников наскальной живописи стал сегодня радиоуглеродный анализ.

Изобразительное искусство в жизни древнего человека играло особенную роль, тесно переплетаясь с религиозными и мифологическими представлениями, что позволяет говорить о его синкретизме.

**Ключевые слова:** петроглифы, наскальная живопись, абсолютное датирование, радиоуглеродный метод, микроэрозия сколов, сравнительный анализ.

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**Жартас беттеріндегі бейнелеу өнері ескерткіштерінің мерзімделуіндегі жаратылыстану ғылымының әдістері**

 Мақала жаратылыстану ғылымдарындағы оның ішінде археология саласындағы өнер ескерткіштерінің мерзімделуінің кейбір ерекшеліктеріне арналады.

 Жаратылыстану ғылымдарының әдістерін пайдалану жартас беттеріндегі бейнелеу өнері ескерткіштерінің мерзімделуінің нақты уақытын анықтаумен қатар, бекітілген мерзімін нақтылау үшінде қазіргі күні белсенді түрде дамып отыр сонымен қатар, ежелгі өнер тарихынның мерзімделу уақыты үшінде аса қажет. Қазіргі күні жартас беттеріндегі бейнелеу өнері ескерткіштерін мерзімдеудегі әдістердің қолданыстағы негізгісі – радиоуглеродтық сараптау.

 Ежелгі адамдардың өмірінде жартас беттеріндегі бейнелеу өнері ерекше негізгі орынды алғаны белгілі, ол діни және мифологиялық сенімдермен байланыса отырып, оның синкретизмі туралы да нақтыланады.

**Кілт сөздер:** петроглифтер, жартастағы бейнелеу өнері, нақты мерзімделу, радиоуглеродтық әдіс, микроэрозия кетіктері, салыстырмалы сараптама.

The use of methods of Natural Sciences in archaeological research has a long history, but they have a particular significance for the study of monuments of rock art and in particular, paintings.

Such methods are included radiocarbon dating, x-ray diffraction, paper chromatography, research of micro erosion of chips, optically stimulated luminescence, CR-method and others.

The use of these or other methods is determined to the presence or absence in the drawings of organic substances, various minerals, climatic conditions where the monument exists.

The results of some methods can be considered quite reliable (by radiocarbon, extracted from the components of the paint or overlapping images of mineral deposits with organic inclusions), other methods are only being developed and the prospects of their use are problematic (CR, and etc.), some is seemed to be reasonably rejected (lichenometry), so such methods are used to call experimental [1, p.17].

Using of Natural science method has made a kind of “revolution” in the dating of works of rock art. If during the XIX century scientists could determine their age only presumably, based on far from indisputable and imperfect systems of classification and comparative analysis, the achievements of Chemistry, Physics and Biology allowed to significantly clarify the chronology and stages of development of creativity of early people.

The problem of studying fine arts requires the involvement of research of various scientific disciplines, and, consequently different methods. The position of the monuments of the primitive art in modern archaeology is not well-defined. No one denies their importance for the understanding of cultural and historical processes, but at the same time the identity of visual materials has not yet become the subject of methodological and theoretical analysis, and therefore tangible results in the research of primitive art are obtained mainly by archaeological methods. Analysis, synthesis, comparative and typological analysis permit us to carry Parallels between different monuments of art, revealing their similarities and differences.

**Application of Natural scientific methods**

For the greater part of the XX century was regarded the most authoritative chronological system of classification of art monuments of the stone age, proposed by the French researchers A. Breuil and A. Leroi - Gourhan. They are both based their concepts on the linear development of art. According to the scheme of A. Breuil was allocated two consecutive cycles in the development of rock art in Europe: aurignac-perigordine and solute-Madeleine. In the middle 60s of the XX century by formulated the classification of images and based on the structural analysis of images, works of Paleolithic art are divided into 4 styles by A. Leroi - Gourhan, replacing each other (primitive period (style 1 and 2, aurignac), archaic period (style 3, late solute), classical period (style 4 ancient, Madeleine), late period (style 4 late, late Madeleine).

However, in 1989 the system of A. Leroi - Gourhan was exposed to serious criticism. The painting in the French cave Gargas were dated by the means of radiocarbon method of Dating 26 820 ± 420 years ago. On the basis of the system of A. Leroi - Gourhan their age was determined to be 8 thousand years older, that is about 34 thousand years ago.

 With the discovery of “classical” rock art in the French cave of Shove (in 1994 there was found a painting dated 32 thousand years ago) and Koske (1991), and obtaining a series of dates for paintings in them, arise the question about the validity of the conclusions, according to which primitive art was developed on a single-line scheme with a consistent change of one artistic style to another [2, p.29].

 As a rule, absolute dates are defined by radiocarbon analysis on organic residues that are part of the dye used in ancient painting. Radiocarbon dating is the most accurate methods in present time, can only carried out if the composition of dye contains charcoal. This process was extremely difficult because a very large amount of dye was needed for the analysis. Therefore, for research there were taken organic remains, found in layers that overlap the painting, although, this led to large errors in the dating. However such situations were rare.

 Later, it became possible to date the pigment itself, which made the image. Nowadays, in determining the chronology of the monument began to use the so-called method of modification of radiocarbon Dating (AMS), which let you do with a minimum amount of colorful material. The size of the sample suitable for radiocarbon dating using a mass spectrometer (AMS C14) is a thousand times smaller than those analyzed by the traditional method of counting the radiation of particles and whose mass ranged from 1 to 3 and up to 10 g. [1]. This method allows holding direct calculation preserved in the excited accelerator sample atoms 14 with the help of the mass spectrometer, and sufficient sample mass of 0.5 mg is enough for carrying out analysis. It was a possible Dating of ancient painting is not from case to case, and need a volume series. The use of radioisotope methods for Dating of ancient painting will play the same revolutionary significance as it has for other ancient objects [3, p.7].

 However, with the help of the most reliable AMS method, only the date of death of the plant is determined from which the coal for the pigment was obtained, but not the time of application of the image itself.

 If we assume that the wood was burned, and the coal was used for painting, some ages have been already had, it becomes clear that it is possible to accurately determine the age of the paint pigment, but not necessarily the time of painting.

 Some paintings within one art complex could be executed by more ancient coal from deposits in a cave. In other cases, they may have been renovated later. It also confuses the picture of the origin of the entire artistic monument [4, p.31]. So, for example, in the cave Cunyak (France) were taken analysis of dye with paintings of deer and horse – two samples from each. The scientists have determined the date for the image of deer in 23 610 ± 350 and 22 750 ± 390; and for the horse: 25 120 ± 390 and 19 300 ± 270. It turns out that two dates of the same picture shared 6 thousand years. Most likely, this fact says that, in the case of necessity the paintings were renovated, which indicates how the tradition of painting was stable, if 6 thousand years after the creation of the painting it was still tried to keep. So, paintings played a significant role in the life of primitive human being.

 Three radiocarbon dates on the coals from the cultural layer of the so-called great hall of Ignatius cave (Russia) attributed the creation of its paintings to: 14 240 ± 150; 13 335 ± 193; 10 400 ± 465 years ago.

 The pigment samples and the base of the wall from Ignatius cave were selected for a more accurate study of the chemical composition of ancient paints and for the possible production of radiocarbon dates for paintings. As a result of the analysis, the images were much younger than expected: mammoth - 7370 ± 50, line – 6030 ± 100 [5].

      The depiction of extinct animals, as in this case, was suggested that mammoths belong to the Paleolithic age. Although other evidence on this monument should be taken into account, these dates cannot be ignored, especially as doubts were expressed about the Paleolithic age of paintings in Ignatius cave [6].

        Another way to determine the age of ancient paintings is – dating microorganisms enclosed in rock drifts. It gives a fairly accurate way to define the age of the engravings. However, depending on the degree of exposure to sunlight, wind direction and other climatic conditions, such drips even on the surface of the same rock can be formed at different speeds and intensities, and consequently, the colonies of microorganisms fall into them at different times.

 Rock art in some cases helps to date itself. The painting often shows the extinct animal, the habitat is known to us. These mammoths, fossil rhinos, or even those animals that exist today, but have been left a certain region long time ago, for example – reindeer for South-Western Europe.

 For a long time, the stylistic analysis of A. Breuil and A. Leroi - Gourhan was often dominated in determining the age of the paintings. This was facilitated by the fact that it is based on a logical idea that art has evolved from simple, primitive sources to more realistic and technically advanced works.

 It is incorrect to adhere to only one method of dating when determining the age of monuments of Paleolithic art. A large proportion of subjectivity is inherent, as we can see, not only scientific methods based on a detailed analysis of the content, relative positions and combinations of certain images, but also methods of Natural science, which take as a basis for their research materials from these ancient paintings where they were created. Only the combination of these two techniques can lead to really correct conclusions.

 New and more precise absolute dating of Paleolithic art has led to a major investigation. Thus, it was found that the paintings of many caves were created at different times. For example, in Altamira this process took place in at least 4 stages, which is confirmed by the study of the cultural layer of the cave. The earliest images were of dynamic and expressive dye of red horses, and then appeared a series of polychrome bison. Thanks for the radiocarbon dating method, the age of the paintings on the large Altamira plafond was identified – they appeared from 15 to 13 thousand years ago. The dates of the images, located in other parts of the cave, gave a wider time frame: from 16 480 to 14 650 years ago [7, p.54].

 The images that covered the walls of Koske, corresponded to 2 different chronological periods. The first of these refers to about 27 thousand years ago, and it is represented by stencil images of hands, often shown with the forearms, and with devoid of phalanges fingers.

 The second phase of the visual tradition of the cave Koske is separated from us by 18.5-19 thousand years [8]. Its picturesque tradition is dominated by images of animals as -horses, goats, bison and gazelle, there are also unique figures of marine animals and birds. Thus, these two groups of paintings are separated by 10 thousand years. This means that either the monument has been used for such a long time as a place of rituals or having been interrupted for several millennia for some reason, the artistic tradition has resumed again.

 All these facts were confirmed the guess of A. Breuil about the long-term accumulation of paintings for a large period of time. Consequently, the caves were used as sanctuaries for a very long time and they were of great value for ancient people in themselves as a repository of ancestral experience.

 Certainly, the researchers of the paintings of ancient Stone Age do not raise only the question of dating monuments. Many disputes are caused by the subjects of rock paintings, their location in space, technique and reasons for their execution. There is no doubt that initially the boundaries between the artistic and non-artistic spheres of human activity were very uncertain, vague, and sometimes just elusive [9], and therefore, its syncretism of ancient art can be correctly understood only in connection with other aspects of society, its structure, worldview, taken as a single and integral system.

 Natural science methods used for dating of paintings made with the help of a colorful pigment and for engraving, scratched on the surface of the rock are different. The presence of organic residues in the paintings, as a rule, allows dating them more accurately. For petroglyths, it is possible to use an optical method for studying micro erosions, which permits to measure the degree of erosion of petroglyths and compare the data with the erosion of those parts of the stone canvas whose age is known [10]. Another way is to use the method of cation relation, based on the study of desert tanning surface on which the engraving.

In 1981, numerous petroglyphs were discovered in the Koa river valley in Portugal. The paintings are located on the banks of the river and are constantly covered with water spills that prevent the determination of the age of the engravings. Thereby, some figures of the archaic (Paleolithic) style, which are slightly, strongly destroyed under the influence of the environment, while others have little or no patina, one of the main is evidence of the antiquity of the petroglyth. Their dating caused a lively discussion, and researchers attributed the engraving to the time from the Paleolithic to the Neolithic. Robert Bednarik used a new method of analysis of micro erosion of chips in the study of petroglyphs [11]. He measured the degree of smoothness of chips on the crystals of feldspar, which appeared under the influence of various natural and anthropogenic factors. The received dates by him allowed it to refer the paintings to the Neolithic.

 The radiocarbon analysis carried out by Watchman gave an age of first 2000-7000 years, and then, more precisely 4000-6000 years (that is, outside the ancient stone age) [11].

 On the basis of thermo-luminescent analysis of material remains (tools, pieces of chalcedony) from the settlements of the ancient stone age, found inside the valley, the group of authors (N. Mercier, T. Aubrey, Zh.Zilano) [12, p.229] indicate about the belonging of these petroglyths to the Paleolithic (approximately periods from Gravette to Madeleine).

The application of Natural science methods for dating rock art monuments is one of the most prospective areas of interdisciplinary scientific knowledge. Despite of occurring controversial issues, it is the methods of Natural sciences, especially in conjunction with other methods, allows obtaining absolute dates for works of art created by ancient people.

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